Chapter I

Introduction

Motivation, and Scope

Batch melting is the most important step of the glass melting process. Since batch melting is the first step of the glass melting, it controls the overall rate. Many scientist have been interested in a deeper understanding of the batch melting process. Those scientist have made their own researches to investigate the melting behavior and try to predict the melting behavior.

Two recent technological trends are about to change the technology of batch melting. These are: Up-grading of recycled cullet, and installation of effective offgas filter systems. For these reasons, the development of batch melting is going to take 3 chances:

1. Use of large amounts of cullet in the melting process.

Now, many kinds of glass are produced and a lot of used glass will affect the environment. The ways to recycle this glass are researched by many glass scientists. Glass recycling is known to decrease the cost of energy.

2. Prepare ground cullet.

Stable cullet supply has encouraged secondary industries to up-grade cullet as a product with small grain sizes (cullet grinding). Ground cullet is easily mixed into the batch like any other raw materials.

3. Filter

Many years ago, the emission of hazardous offgas gasses such as HF, HCl, NO_x etc. were limited by the governments of several countries. Because of the

toxic gases, glass batch were not permitted to contain raw materials that could emit toxic gasses. But now, filter technologies have been developed to correct this problem. The filter can be used to filtrate dust and the toxic gasses. The important about gas pollution is decreased and some additives found to enhance melting in glass batch can be taken in serious consideration again.

Batch melting has been investigated previously in our lab at Chulalongkorn university, too. The study focused on the processes controlling the rate of glass batch melting. Thermocouple and electrodes were used as a tool to measure the thermal and chemical effects in batch blankets. These experiments demonstrated the possibility to used both of thermocouple and electrodes in batch blankets. However, the measurement was quite slow. So it was desirable to develop the method for fast automatic recording.

Objective

It is the objective of the present thesis to developed the equipment for fast automatic recording by computer, and to improve some of the essential shortcomings of the pioneer work, such as the batch charging method, temperature control in the furnace, independent heating of melt and atmosphere, etc. The developed experimental tools are applied to a series of batches containing varying amount of ground cullet.

Literature survey

Since 1952, scientists have started to study the thermochemistry of batch melting and not many papers were published. After that, a group of the scientists concentrated on the field of the physical and mathematical melting model. In 1969 and 1985, Buntig and Bieler studied the time that the batch required to melt down to

98% after being charged on to the melt. From those experiments, we know that the mass of the batch per surface is an important parameter. Others groups of the scientists such as Sheckler (1990) tried to use a computer program to calculate the kinetic of the glass batch melting, but their basic data did not allow to come to general conclusions. Daniels (1973) and later Faber et al. (1992) studied in-depth the importance of the temperature distribution in a melting batch in the kilogram range. Daniels also wrote about resistivity measurements, but he did not report any results. Then, Conradt and co-worker (1994) studied about the measurement of the temperature distribution in batch blankets combined with electrical resistivity detection, used to proof primary liquid phase formation. By this method, the temperature field in a batch heap could be set into relation to the local physical and chemical events in the batch.